

REMARKS/ARGUMENTS

Favorable reconsideration of this application is requested in view of the above amendments and in light of the following remarks and discussion.

Claims 1-3, 5-7, 10, 12-13, and 15-25 are pending. Support for the amendment to Claim 1 can be found in now-canceled Claims 4 and 46, for example. Support for the amendment to Claim 5 can be found in now-canceled Claims 8 and 47, for example. Claims 4, 8, 11, 14, and 26-47 are canceled without prejudice or disclaimer. Figs. 1 and 7 are amended. Support for the amendments to the Figures is self-evident. No new matter is added.

In the outstanding Office Action, Figs. 1 and 7 were objected to. Claims 1, 5, 10, 12, 13, and 15-25 were provisionally rejected on the ground of non-statutory obviousness-type double patenting as obvious over Claims 1, 3-5, 7, 9-14, and 16-18 of copending application No. 10/722,602 in view of Selwyn et al. (U.S. Patent No. 5,716,486, herein “Selwyn”) and Kholodenko et al. (U.S. Patent No. 5,942,039, herein “Kholodenko”). Claims 1, 4, 5, and 8 were rejected under 35 U.S.C. § 103(a) as obvious over Selwyn in view of Kholodenko. Claims 2, 3, 6, and 7 were rejected under 35 U.S.C. § 103(a) as obvious over Selwyn, Kholodenko, and Hong et al. (U.S. Patent No. 5,897,752, herein “Hong”). Claims 10, 13, 16-18, 21, and 23-25 were rejected under 35 U.S.C. § 103(a) as obvious over Selwyn in view of Kholodenko, and further in view of O'Donnell et al. (U.S. Patent Pub. 2005/015,0866, herein “O'Donnell”) and Fakuda et al. (U.S. Patent Pub. 2003/0113479, herein “Fukuda”). Claims 12, 19, and 20 were rejected under 35 U.S.C. § 103(a) as obvious over Selwyn in view of Kholodenko, O'Donnell, Fakuda, and further in view of George et al. (U.S. Patent No 4,357,387, herein “George”). Claims 15 and 22 were rejected under 35 U.S.C. § 103(a) as obvious over Selwyn in view of Kholodenko, O'Donnell, Fakuda, and Panitz et al. (U.S. Patent No. 5,925,228, herein “Panitz”). Claims 46 and 47 were rejected under 35 U.S.C.

§ 103(a) as obvious over Selwyn, Kholodenko, and Hao et al. (U.S. Patent No. 6,363,882), herein “Hao”).

Regarding the objection to the drawings, replacement sheets including Figs. 1 and 7 are submitted herewith. In replacement Fig. 1, reference numerals (45) and (46) are switched. In Fig. 7, the reference numeral (92B) is replaced by (92A) as suggested in the outstanding Office Action. Accordingly, Applicants respectfully submit that the objection to the drawings is overcome.

Regarding the rejection of Claims 1, 5, 10, 12, 13, and 15-25 on the ground of non-statutory obviousness-type double patenting over Claims 1, 3-5, 7, 9-14, and 16-18 of copending Application No. 10/722,602 in view of Selwyn and Kholodenko, that rejection is respectfully traversed by the present response.

A Terminal Disclaimer against Application No. 10/722,602 is submitted herewith. Accordingly, Applicants respectfully submit that the rejection on the ground of non-statutory obviousness-type double patenting is overcome.

By way of review, the present invention, as recited in amended independent Claim 1, is directed to a plasma processing apparatus and a ring member employed in the plasma processing apparatus. The plasma processing apparatus recited in amended Claim 1 includes a ring member installed to surround the substrate and spaced apart from an outer periphery of the substrate. **The top surface of the ring member is substantially flush with a top surface of the substrate.** The apparatus further includes **a plurality of electrodes embedded inside the ring member along a diametrical direction and a plurality of DC power supplies for applying DC voltages, each of which is adjusted independently.**

By forming the top surfaces of the ring member and the substrate to be flush with each other, the condition of the sheath region formed above an outer periphery of the substrate is made identical to that at a central portion, thereby enhancing radial uniformity of

the plasma. Moreover, by providing a plurality of electrodes in a diametrical direction and adjusting a voltage applied thereto independently, the thickness of the sheath region above the ring member is finely adjusted. Therefore, in-surface uniformity of a plasma processing and controllability of the thickness of the sheath region are improved.

Selwyn describes a couple of buried elements (90) provided underneath an outer periphery of the substrate. Further, Selwyn describes, in Fig. 13, separate voltage sources (92a, 92b) connected to each of the buried elements (90).

Kholodenko describes a focus ring (90) which includes a dielectric barrier (92) and an electrical conductor element (100) covered by the dielectric barrier (92) and electrically isolated from a plasma.

Hao describes that a top surface of an edge ring (156) is arranged to be slightly below or **about** the same level as the top surface of the substrate.

However, none of the cited references and/or any proper combination thereof expressly teaches or suggests providing a plurality of electrodes embedded in a diametrical direction in a ring member, each being connected to an independently controllable DC voltage supply, and a top surface of the ring member **being substantially flush** with a top surface of the substrate.

Inasmuch as the features of now-canceled Claim 46 are incorporated into amended independent Claim 1, Applicants address the rejection of now-canceled dependent Claim 46 in the discussion of amended independent Claim 1.

The outstanding Office Action acknowledges that Selwyn and Kholodenko fail to teach or suggest a top surface of a ring member substantially flush with a top surface of a substrate.¹ The outstanding Office Action relies on Hao for the above-noted feature.

¹ Outstanding Office Action, page 9.

The edge ring (156) in Hao is simply for shielding electrodes (152) and a chuck (154), having nothing to do with forming and adjusting a plasma sheath region above the edge ring (156). Further, as stated in col. 6, lines 25-29 of Hao, arranging the top surfaces of the edge ring (156) and the substrate at **about** the same level is for forming a recessed portion for accepting the substrate. Therefore, the above-mentioned feature disclosed in Hao does not correspond to the feature that the top surface of the ring member is **substantially flush** with a top surface of the substrate, as recited in amended Claim 1.

Additionally, Applicants respectfully submit that a person of ordinary skill in the art would not combine Hao and Kholodenko so as to provide a ring member formed of an insulating material, a top surface of which is **substantially flush** with a top surface of a substrate as recited in amended independent Claim 1. Rather, Kholodenko requires its focus ring (90) to extend **above** the level of the substrate (25) in order to direct the flow of process gas or plasma to the substrate (25). Kholodenko states:

A composite, electrically activated, self-cleaning focus ring 90 is positioned around the substrate 25. The focus ring 90 can form a free-standing dielectric structure resting on the substrate support 75, or a dielectric structure attached to and extending from the sidewall 35 of the process chamber 30. Referring to FIGS. 1 and 2, the focus ring 90 comprises a dielectric barrier 92 shaped and sized to be positioned around the perimeter 80 of the substrate 25 **for containing and directing the flow of process gas or plasma to the substrate 25**. The inner diameter of the dielectric barrier 92 is sized sufficiently large to encircle the perimeter of the substrate 25. For example, for substrates having a diameter of 200 mm (about 8-inch), a suitable inner diameter is from about 201 mm to about 210 mm, and more preferably from about 201 mm to about 205 mm. **The height of the dielectric barrier 92 for a 6-to-12 inch diameter substrate is preferably from about 15 mm to about 25 mm.**

Preferably, the dielectric barrier 92 has a plasma (or process gas) focusing surface 95 abutting and extending substantially continuously along the perimeter 85 of the substrate 25 for focusing the plasma onto the substrate surface 80, and an opposing surface 98 on the other side of the barrier 92. Preferably, the plasma focusing surface 95 of the dielectric barrier 92 forms an **inverted conical surface extending above**

and surrounding the substrate surface to direct process gas to the substrate 25 substantially without interfering with or blocking the flow of the process gas.²

Kholodenko requires the focus ring to be able to direct plasma gas toward the substrate, and Applicants respectfully submit that a person of ordinary skill in the art reading Kholodenko would not be motivated to combine Kholodenko and Hao such that a focus ring with a top surface substantially flush with a top surface of a substrate would be produced. Accordingly, Applicants respectfully submit that amended independent Claim 1 further patentably distinguishes over any proper combination of the cited references for at least the reasons discussed above.

Amended independent Claim 5 recites substantially similar features to those discussed above regarding amended independent Claim 1 and patentably distinguishes over any proper combination of the cited references for at least the same reasons as amended independent Claim 1 does.

Each of Claims 2-3, 6-7, 10, 12-13, and 15-25 depends from one of amended independent Claims 1 and 5 and patentably distinguishes over any proper combination of the cited references for at least the same reasons as amended independent Claims 1 and 5 do.

Hong fails to remedy the deficiencies discussed above regarding any proper combination of Selwyn, Kholodenko, and Hao. Rather, Hong describes a clamp ring (40) extending a few millimeters above the top surface of the wafer (16).³

O'Donnell fails to remedy the deficiencies of the references discussed above. O'Donnell describes a substrate support (44) with a gas ring (40) surrounding the substrate support (44). O'Donnell is devoid of any teaching or suggestion or a ring member formed of an insulating material installed to surround a substrate and having a top surface substantially flush with a top of the substrate as recited in amended independent Claims 1 and 5.

² Kholodenko, col. 3, lines 29-55 (emphasis added).

³ Hong, col. 4, lines 66-67.

Accordingly, no proper combination of O'Donnell and the above-noted references would include all of the features recited in either of amended independent Claims 1 and 5.

Neither George nor Panitz describes any structure specifically related to a ring member as recited in amended independent Claims 1 and 5, and accordingly, George and Panitz fail to remedy the deficiencies discussed above in the remaining cited reference.

For the foregoing reasons, it is respectfully submitted that this application is now in condition for allowance. A Notice of Allowance for Claims 1-3, 5-7, 10, 12-13, and 15-25 is earnestly solicited.

Should Examiner Dhingra deem that any further action is necessary to place this application in even better form for allowance, Examiner Dhingra is encouraged to contact Applicants' undersigned representative at the below-listed telephone number.

Respectfully submitted,

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IN THE DRAWINGS

The attached sheets of drawings include changes to Figs. 1 and 7. These sheets, which include Figs. 1 and 7, respectively, replace the original sheets including Figs. 1 and 7.

Attachment: Replacement Sheets (2)